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THE MESOSTIGMATID MITE (ACARI, MESOSTIGMATA) COMMUNITY IN CANOPIES OF SITKA SPRUCE IN IRELAND AND A COMPARISON WITH GROUND MOSS HABITATS

J. Arroyo[1], M. L. Moraza[2] & T. Bolger[1]

SUMMARY

J. Arroyo, M. L. Moraza & T. Bolger. 2010. The Mesostigmatid mite (Acari, Mesostigmata) community in canopies of Sitka spruce in Ireland and a comparison with ground moss habitats. *Graellsia*, 66(1): 29-37.

The main aim of this study was to examine the communities of mesostigmatid mites occurring in Irish Sitka spruce (*Picea sitchensis*) canopies or inhabiting moss, either in the canopy or on the soil surface, and to discover whether a characteristic assemblage of species occurs in particular habitat patches (ground vs. aerial). Twenty two species of Mesostigmata were recorded, of which five occurred exclusively in arboreal microhabitats. All three species of Zerconidae collected were unique to the canopy and moss mats on the tree branches. *Trachytes aegrota* (C.L. Koch, 1841) was recorded for the first time in Ireland and some comments about its distribution are made. Multivariate analysis indicated that the arboreal mesostigmatid community is not just a subset of the assemblage occurring in moss on soil or trunks and that it appears to be more homogeneous than those occurring on the soil surface.

Key words: Acari; Mesostigmata; canopy; arboreal mites; Sitka spruce; Ireland.

RESUMEN

J. Arroyo, M. L. Moraza & T. Bolger. 2010. La comunidad de ácaros Mesostigmata (Acari, Mesostigmata) en el dosel arbóreo de bosques de pícea en Irlanda en comparación con la presente en hábitats muscícolas edáficos. *Graellsia*, 66(1): 29-37 (en inglés).

El objetivo principal de este trabajo fue estudiar en Irlanda las comunidades de ácaros Mesostigmata del dosel arbóreo de bosques de *Picea sitchensis* y en el musgo desarrollado tanto en zonas aéreas como en la superficie edáfica, con el fin de determinar si la estructura y composición de éstas comunidades variaba entre los hábitats diferenciales (edáficos vs. aéreos). Se obtuvieron 22 especies de ácaros Mesostigmata, de las cuales 5 aparecieron solamente en micro-hábitats arbóreos. Las especies de la familia Zerconidae recogidas en este estudio se encontraron exclusivamente en ramas y musgos desarrollados en el dosel. *Trachytes aegrota* (C.L. Koch, 1841), es citado por primera vez para Irlanda. Se ofrecen asimismo comentarios sobre la distribución de esta especie. El análisis multivariante de los resultados indicó que las poblaciones arbóreas de ácaros Mesostigmata no son un mero

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subconjunto estructural sino que forman una comunidad diferencial respecto a las presentes en hábitats muscícolas del tronco o del medio edáfico, y son más homogéneas que las existentes en la superficie del suelo.

Palabras clave: Acaros; Mesostigmata; dosel; ácaros arbóreos; *Picea*; Irlanda.

Introduction

Sitka spruce –*Picea sitchensis* (Bong.) Carr. (1832)–, a species native to North America, has been used widely for afforestation purposes in Ireland. It is chosen because it is a productive canopy species (Forest Service, 2000).

Although forest is the climax vegetation for most of Ireland, due to deforestation, only approximately 10% of the land is currently forested and more than 90% of the forests are plantations of exotic trees such as the aforementioned Sitka spruce (Fahy & Foley, 2002).

Little is known of the biota inhabiting these plantations (Bolger, 2002) and this is especially the case for invertebrate fauna (Fahy & Gormally, 1998). Recent research carried out by our team in these forests has increased our knowledge of the composition of the mite assemblages in these habitats (Arroyo & Bolger, 2007; Moraza *et al*., 2009; Arroyo *et al*., 2009). Oribatid mites show high abundance and diversity in canopies (Behan-Pelletier & Walter, 2000) and are the mites most studied in these ecological habitats. However, mesostigmatid mites also occur in canopies and their assemblages have been researched in this study. The importance of researching in these habitats is highlighted by the fact that forest canopies support diverse arthropod assemblages, which are largely distinct from those on the forest floor (e.g. for mites Walter & Bellan-Pelletier, 1999). Indeed, Winchester (1997) points out that the distinct assemblage of oribatid mites inhabiting the canopy of coniferous trees in Western North America has been used as one of arguments for the conservation of these old-growth forests

The main goals of the current study were:

- To determine the species composition of the mesostigmatid fauna in Irish Sitka spruce stands.
- To study the community assemblages of Mesostigmata mites in several microhabitats within Sitka spruce stands.
- To test whether there are distinct assemblages in the microhabitats sampled.

Materials and Methods

The sampling was carried out in December 2005 and 2006 in two different aged Sitka spruce plantations located in Co Laois, Ireland (Fig. 1):

- Baunreagh: stand planted in 1925. Elevation: 360 m. Coordinates: ~53º 07´N, 7º 34´W
- Dooary: stand planted in 1990. Elevation: 200 m. Coordinates: ~52º 57´N, 7º 15´W

Further details can be found in Arroyo *et al*. (2009) and Black *et al*. (2007).

In Baunreagh, samples were collected from five randomly selected trees by climbers and, in Dooary, from three trees by the senior author, using a portable climbing tower. The sampling followed protocols developed by Finnamore *et al.* (2004) and Behan-Pelletier (com. pers., 2005). Five sections of one branch approximately 25 cm in length and with a similar diameter were collected in each tree from the top of the living crown (~ 40 m Baunreagh / 11 m Dooary), mid crown (~ 38 m / 10 m) and at the bottom of the living canopy (~ 36 m / 9 m). The main epiphytic moss cover was removed and the branches and twigs were bathed in a dilute solution of NaOH for 48 hours. The liquid was then filtered (85 µ mesh size) and the animals collected. The subsamples collected from each branch were combined for each height within an individual tree to make a composite sample. This makes five replicate trees and three heights giving a total of 15 canopy samples coded as CT B for the Baunreagh site and three replicate trees and three heights accounting for a total of 9 canopy samples coded as CT D for the Dooary stand.

In the Baunreagh forest (oldest site), the moss cover developed in the branches was made up mainly of *Hypnum cupressiforme* Hedwig, 1801 at the three heights. This epiphytic material was carefully recovered and the mite fauna occurring in it extracted using Berlese funnels (Coineau, 1974). In this microhabitat we had five trees and 3 heights accounting for a total of 15 bryophytes samples coded as CM B. The samples were variable in size and were taken from the junction of the trunk and the selected

Fig. 1.– Location of the Baunreagh and Dooary Sitka Spruce stands in Co Laois, Ireland.

Fig. 1.– Localización en el condado de Laois (Irlanda) de las plantaciones de Baunreagh y Dooary.

branches, at the same heights as the samples of the canopy fauna. The forest growing in Dooary did not have enough epiphytic cover to allow sampling.

In these two arboreal microhabitats all samples for each height class were combined and coded using L/M/U extension for the lower, middle and upper levels. These pooled samples for habitat and plantation were used for the multivariate analysis.

Samples of moss were also taken from other microhabitats in both plantations and the biota was extracted using a Berlese funnel over a period of two weeks. Moss mats on the floor were collected using 16 random quadrats (10 x 10) later combined to give two samples for each stand. Baunreagh samples were coded as SM B. The moss community was mainly *Sphagnum* sp, *Thamnobryum alopecurum* (Hedw.), *Polytrichum commune* Hedw., with *Rytidiadelphus loreus* Green and Klinka, 1994 being less abundant. The Dooary soil moss samples were coded as SM D.

In the Baunreagh stand, 8 moss quadrats of 10 x 10 cm were also collected along the upper bark surface of two fallen stems and combined and coded as FTM B. The epicorticolous assemblage was dominated by *H. cupressiforme*.

Finally, at Dooary, samples of the sparse moss mats on the bases of the trunk (0-25 cm) were collected from two trees (coded as TM D).

All adult mesostigmatid mites were slide mounted in Hoyer´s liquid and the more sclerotized animals cleared using Nesbitt's and posteriorly identified to species level using the keys of Karg (1993), Hyatt & Emberson (1988) and Evans & Till (1979).

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Table 1.– Species check list and population abundance. Codes (Baunreagh site): CT: canopy (branches) habitat, CM: canopy moss habitat, SM: moss floor habitat, FTM: fallen trunk moss habitat. Codes (Dooary site): CT: canopy (branches) habitat, SM: moss floor habitat, TM: Trunk moss habitat. Both sites : L: Lower height in canopy, M: middle height, U: upper height.

Tabla 1.– Listado de especies y abundancias. Plantación en Baunreagh (códigos): CT: habitat dosel (ramas), CM: hábitat muscícola en ramas del dosel, SM: habitat de musgo edáfico, FTM: cubierta muscícola en pies caídos. Plantación en Dooary (códigos): habitat dosel (ramas), SM: habitat de musgo edáfico, TM: cubierta muscícola del tronco. Para ambas: L: altura inferior en el dosel, M: altura media, U: altura superior.

Species / Habitats and samples (x/y)*	**CTL** (5/1)	**CTM** (5/2)	**CTU** (5/4)	**CML** (5/2)	**CMM** (5/3)	**CMU** (5/4)	**SM** (3/3)	**FTM** (2/2)	**CTL** (3/2)	**CTM** (3/2)	**CTU** (3/2)	**SM** (3/3)	**TM** (2/2)
				BAUNREAGH SITE							**DOOARY SITE**		
Amblyseius nr *obtusus* (C.L. Koch, 1839)				1	1	1							
Anthoseius sp												1	
Cilliba cassidea (Hermann, 1804)						4		3				1	
Dinychus perforatus Kramer, 1886													1
Geholaspis longispinosa (Kramer, 1876)						1							
Holoparasitus stramenti Karg, 1971												1	1
Lysigamasus armatus Halbert 1915											1		
L. runciger (Berlese, 1904)							1						1
Macrocheles submotus Falconer, 1924							1						
Paragamasus alpestres (Berlese, 1904)													3
P. diversus (Halbert, 1915)													1
P. robustus (Oudemans, 1902)								1				1	5
Pergamasus crassipes (Linné, 1758)					2		1					9	17
P. septentrionalis Oudemans, 1902													1
Trachytes aegrota (C.L. Koch, 1841)								1	1	2			42
Trachytes sp												1	5
Typhlodromus sp		1	1						1				
Uropoda minima Kramer, 1882						1	1						
Veigaia nemorensis (C.L. Koch, 1839)						1							
Zercon darai Moraza, 2009			2	1	1	1							
Z. curryii Moraza *et al.*, 2009			1	1									
Z. hibernia Moraza *et al.*, 2009	1	1	9			1				5	3		

* **(x / y) number of samples as** x: total samples in a habitat and y: samples containing mites.

Data Analyses

A multivariate analysis was carried out to explore the relationships between the different habitats and the mite assemblages inhabiting them. The ordination algorithm used was a Detrented Correspondence Analysis (DCA) using CANOCO community ordination program (Ter Braak & Šmilauer, 2002). The DCA was chosen in order to allow representation of rare species and all Mesostigmata taxa, even rare ones, were included in the analysis. It was also chosen because there was a high proportion of zeroes in the data matrix. In a second approach a cluster classification was obtained through TWINSPAN analysis. TWINSPAN is a divisive, hierarchical classification (Hill, 1994) which was carried out to summarise community composition. Samples containing no mites were not used in these analyses.

Results

A total of 146 adult mesostigmatid mites were collected (see Table 1) comprising up to 22 species. One of these is a first record for Ireland of *Trachytes aegrota* (C.L. Koch, 1841).

Of the twenty two species recorded, five were found exclusively in arboreal microhabitats. All three species of *Zercon* collected occurred only in the canopy microhabitats and were new to science, being recently described by Moraza *et al*. (2009).

The DCA (Length of gradient for first axis: 2.88) ordination showed clear clusters related to habitats (Fig. 2) and this was especially evident for canopy microhabitat for both forests. DCA was primarily selected as an indirect ordination technique and the ecological results displayed in the analysis were subsequently confirmed by the TWINSPAN classification (Table 2) which corroborated that the assemblages were divided into two obvious groupings, those from the canopies of both forests and those from the other microhabitats. There is a distinct grouping of species associated with the canopies which includes *Zercon hibernia* Moraza, Arroyo & Bolger 2009*, Zercon darai* Moraza, 2009*, Typhlodromus* sp and *Zercon curryii* Moraza, Arroyo & Bolger 2009. This group also includes *Lysigamasus armatus* Halbert, 1915 while *Trachytes aegrota,* although it was found in the canopies, appears mainly in other samples.

The differences between assemblages of mesostigmatid mites in the different microhabitats showed that communities in canopies are not a subset of ground populations but rather habitats colonized by characteristic fauna including typical or strictly arboreal genera as well as some wandering taxa. This ecological fact is similar for oribatid mites (Proctor *et al*., 2002).

Discussion

The abundance of mites recovered is similar to what others have found for this group for temperate coniferous soils (Čoja & Bruckner, 2003; Huhta, 1996) but is much lower for arboreal samples previously recorded in canopies of *Thuja* (Lindo & Winchester, 2006). In subtropical rain forest from Eastern Australia a relatively species-poor collection of mesostigmatid mites was also found on the surface of tree trunks (Beaulieu *et al*., 2006). In fact, the diversity and abundances shows that the mesostigmatid mites are similarly poor in the canopies of Irish Sitka spruce as were the oribatids (Arroyo *et al*., 2009).

The faunistic records collected were a bit surprising. Although species from the families Phytoseiidae and Uropodidae, commonly found on tree trunks and large stems, especially associated with growths of epicorticolous bryophytes and lichens, were obtained in our study, individuals belonging to the families Ologamasidae and Ascidae, usually collected in these habitats (Andre, 1986; Emmanouel & Panou, 1991), were not collected. The presence in the samples of *Thyplodromus*, *Amblyseius* and *Anthoseius* was expected because Phytoseiidae mites are widely distributed in most terrestrial ecosystems, living in foliage or on the bark of trees and bushes, while some species are common in litter and soil habitats (Evans *et al*., 1985).

Cilliba cassidea and *Trachytes aegrota* have been collected in small numbers in aerial habitat.

The lack of more species belonging to the genus *Veigaia*, apart from *V. nemorensis* (C.L. Koch, 1839) from epiphytic moss, was not surprising because although four species had previously been found in the soil at the Dooary site, none were found in moss (Arroyo & Bolger, 2007).

Several species of Parasitidae and Macrochelidae were found in the moss on the bases of the tree trunks and on the soil surface. For example*, Pergamasus crassipes* (Linné, 1758)*,* a common predatory mite, was collected in moss on the soil sur-

Table 2.– TWINSPAN classification analysis. The habitats researched are coded as in Table 1 and 2 with and added B (Baunreagh) or D (Dooary) for the site.

Tabla 2.– Análisis de clasificación (TWINSPAN). Los hábitats son codificados como en las Tablas 1 y 2 con cola añadida por sitio de estudio: B (Baunreagh), D (Dooary).

	FTM B	TM D	CMM B	CMU B	SM B	SM D	CTM B	CTL D	CTL B	CTU B	CTM D	CTU D	CML B	
P. alpestris	.	1	.	.	.	.	.	.	.	.	.	.	.	0000
P. diversus	.	3	.	.	.	.	.	.	.	.	.	.	.	0000
P. robustus	1	4	.	.	.	1	.	.	.	.	.	.	.	0000
P .septentrionalis	.	5	.	.	.	.	.	.	.	.	.	.	.	0000
M. submotus	.	2	.	.	1	.	.	.	.	.	.	.	.	0001
C. cassidea	2	1	.	2	.	1	.	.	.	.	.	.	.	0010
G. longispinosus	.	1	.	1	.	.	.	.	.	.	.	.	.	0010
Anthoseius sp	.	.	.	.	.	1	.	.	.	.	.	.	.	0011
H. stramenti	.	.	.	.	.	1	.	.	.	.	.	.	.	0011
L. runcinger	.	.	.	.	1	.	.	.	.	.	.	.	.	0011
P. crassipes	.	1	2	.	1	3	.	.	.	.	.	.	.	0011
Trachytes sp	.	.	.	.	.	1	.	.	.	.	.	.	.	0011
U. minima	.	.	.	1	1	.	.	.	.	.	.	.	.	0011
V. nemorensis	.	.	.	1	.	.	.	.	.	.	.	.	.	0011
A. nr *obtusus*	.	.	1	1	.	.	.	.	.	.	.	.	1	01
T. aegrota	1	3	.	.	.	.	.	1	.	.	2	.	.	10
L. armatus	.	1	.	.	.	.	.	.	.	.	.	1	.	110
Z. darai	.	.	1	1	.	.	.	.	.	2	.	.	1	110
Typhlodromus sp	.	.	.	.	.	.	1	1	.	1	.	.	.	111
Z. curryii	.	.	.	.	.	.	.	.	.	1	.	.	1	111
Z. hibernia	.	.	.	1	.	.	1	.	1	3	3	2	.	111
	0	0	0	0	0	0	1	1	1	1	1	1	1	
	0	0	1	1	1	1	0	0	0	0	0	0	1	
							0	0	1	1	1	1		

face and in moss mats developed on stems from Baunreagh. This fact corroborates the wandering behaviour of this species which has been recorded in other coniferous forests such as yews in Great Britain (Thomas & Polwart, 2003).

We offer here the first records of *Trachytes aegrota* for a geographical concrete location within Ireland. Although the island was included in the European distribution map for the species by Błoszyk *et al*. (2003), and this is considered by Wisniewski & Hirschmann (1993) to occur in all of Europe, no specific bibliographic references were offered for these records and the authors are not aware of any. No reference to this taxon is made in the previous works on Ireland (O'Connell, 1994) or in the Acarina check list for the country (Luxton, 1998) or in the reference specimen collection at UCD. *T. aegrota* is commonly found in Sitka habitats as well as other forestry with its abundance declining from north Europe to Mediterranean areas. In Ireland two species of this genus, *T. minima* and *T. oudemansi* have been recorded previously and *sensu* Mašán (2003) most morphological characters of *T. oudemansi* are almost identical with those of *T. aegrota*, which only lacks the broad lateral margins of the vertex in the latter. Mašán's belief that *T. oudemnasi* is synonymous with *T. aegrota* may be justified, but we keep our criteria of considering each a different species.

The three species of *Zercon* collected in this study were recovered exclusively in arboreal habitats and found to be new to science. Together with more type material of these species recovered in canopies researched for our team from *Quercus petreae* and *Taxus baccata* woods, the new *Zercon* species were described (Moraza *et al*., 2009) suggesting the need for deeper research on gamasids inhabiting these ecosystems.

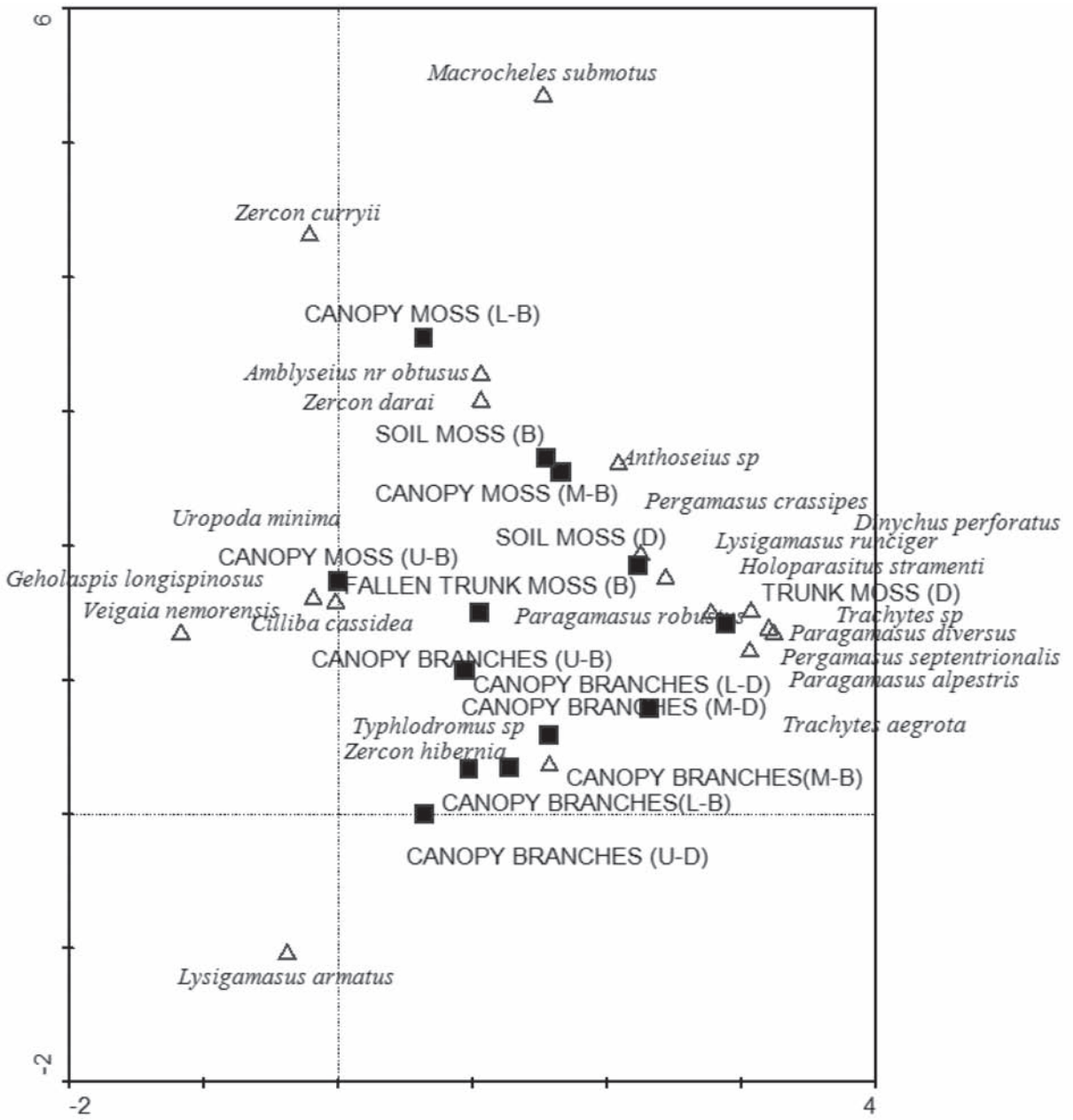

Fig. 2.– Detrented Correspondence Analysis (DCA) biplot. The habitats are displayed in the graph adding a tail: B (Baunreagh) or D (Dooary) for the site and L, M and U for lower, middle and upper height.

Fig. 2.– Diagrama de ordenación basado en el Análisis de Correspondencias sin tendencias (DCA). Los hábitats se muestran en la figura con cola añadida por sitio de estudio: B (Baunreagh), D (Dooary) y por altura: L, M y U codificando inferior, media y superior.

The abundances differed strongly between microhabitats. Beaulieu *et al.* (2006), in their research on Australian rainforest, indicate that the mesostigmatid mite fauna (Uropodina excluded) of tree trunks was mainly composed by a mixed set dominated by suspended soil inhabitants and 'generalist' species, suggesting that tree trunks represent a 'highway' for most Mesostigmata, while others use it as a permanent habitat. In our study the faunistics of the tree trunk moss collected suggest a more differentiated assemblage despite the presence of abundant and common species such as *C. cassidea* and *P. crassipes* which also occurred in the other microhabitats sampled.

The variation found between assemblages of mesostigmatid mites in the canopies in comparison with floor habitats in combination with the data already in the literature for other mites and microarthropods suggests the importance of continued study of the contributions of these assemblages to ecosystem functions because, as Lindo & Winchester (2007) remark, the decomposition process in canopy ecosystems is expected to differ from that of forest floor ecosystems due to biotic factors such as differences in diversity of oribatid mite and other microarthropod assemblages, and abiotic parameters that operate at microscale levels.

Finally as expected, based on previous work carried out by our team, there were low richness and abundance of mites in the canopies (branches) of Irish Sitka spruce, with increased diversity in the epiphytic mat microhabitats, but even in these niches, the richness and diversity is depauparate when compared with the fauna of native coniferous forest in North America, and specially in Sitka spruce, which is native to that geographical area.

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